The Corrector

Iteration 1 Substep 2 **January 1995**

A NEWSLETTER FOR THE NPARC USERS ASSOCIATION

From the Support Team

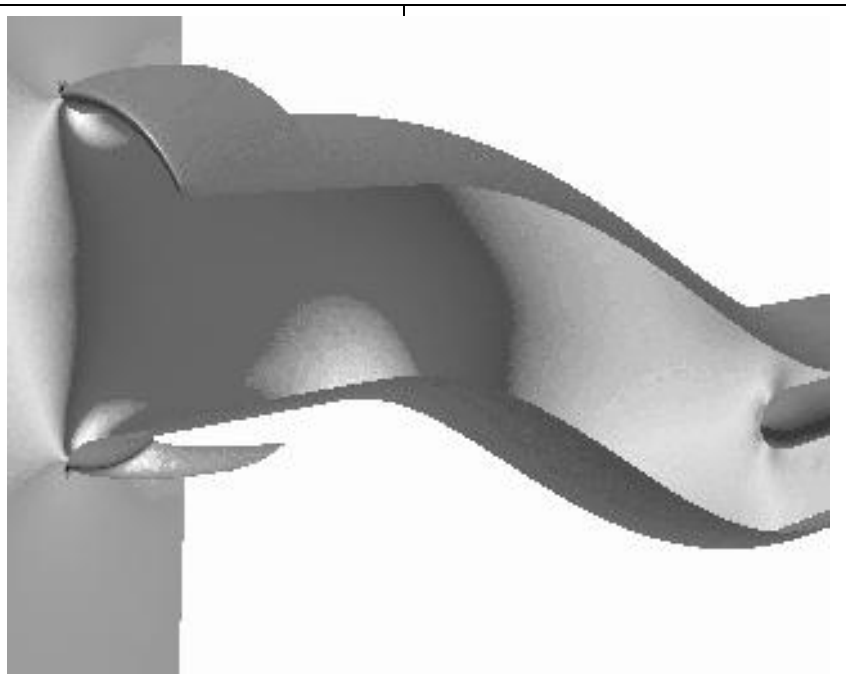
Our goal is to provide the users with NPARC support and information in a timely fashion. The Predictor/ Corrector newsletter is intended to have wide dissemination, but is not intended as the primary source of communication between the NPARC Alliance and the user community. To meet our criteria for timely information exchange, the primary means of communication is electronic.

Our World Wide Web server is publicly available and contains a wealth of information including abstracts for references, links to Home Pages for grid generation and flow visualization software, and a bulletin board for the use of NPARC user's. Our WWW URL is: http://info.arnold.af.mil/nparc.

To provide the most rapid communication concerning the most pressing information, electronic mail is the tool of choice. If you do not receive e-mail messages concerning bug fixes or code releases, please contact the NPARC support line:

e-mail:
nparc-support@info.arnold.af.mil

phone:
(615) 454-7455



Mach number contours for one of the example cases included in the new user's manual.

What's Inside

Version 2.0 Released

Version 2.0 of NPARC was released in November. The major new feature of Version 2.0 is a completely revised User's Manual. The new manual has been designed to provide information for both novice and experienced users. For novice users, sections on "getting started" and "usage basics" provide enough detail to handle installation and operation of the code for simple cases. A more detailed reference chapter is provided to guide the user through more complex problem set up. A resource chapter is also provided to direct the user to additional information sources.

In the appendix, detailed descriptions of three example cases can be found: a turbulent flat plate, a subsonic S-duct diffuser, and a supersonic jet. The discussion for each case includes descriptions of the code setup, runstreams, timings and results.

There have also been some algorithmic and physical modeling changes between Versions 1.2a and 2.0. Primarily, two turbulence models have been added: the one-equation Baldwin-Barth model and the algebraic RNG model.

For further information contact the NPARC support hotline by phone or e-mail.

WWW Update

The NPARC Alliance is continuing to update the information and services provided through the World Wide Web. The NPARC Home Page is publicly available at URL http://info.arnold.af.mil/nparc. NPARC documentation is included on the Web in both PostScript form and as hypertext. The hypertext version is a first step toward on-line documentation. Hypertext links point to each section in the document for easy navigation. Users can also search for particular keywords using the WWW browser (e.g. Mosaic) capabilities.

The NPARC reference section has been greatly enhanced with over 100 citations from many organizations. Abstracts and full papers are also available for many of these citations. A search capability is available to aid the user in locating particular authors or key words. Let us know of any papers or reports which are in any way related to NPARC but have been excluded from the list.

New to the NPARC Home Page is information on pre- and post-processing software. Brief summaries of grid generation and flow visualization software are provided with links to appropriate WWW Home Pages where available.

Let us know what you think.

Parallel NPARC Effort

A parallel version of the NPARC code is currently under development. This version of the code will exploit the multiblock functionality of NPARC. It will be possible to run multiple grid blocks simultaneously on multiple UNIX workstations, thus providing improved performance over that using a single workstation.

A workshop on parallel processing and the NPARC code was held at NASA Lewis in October. Participants included Boeing, McDonnell Douglas, AEDC and NASA Lewis. Several of the participants already have parallel codes in operation, including versions of the PARC code. The workshop participants are collaborating to develop a robust parallel version of NPARC. Availability is planned for November, 1995.

User Association Meeting

Approximately 20 NPARC users attended the User Association Meeting held June at the 30th Joint Propulsion Conference in Indianapolis. A general presentation of the Alliance activities was made.

Two major issues were discussed. The first one was the scope of the NPARC Alliance role in supporting the NPARC code. Some felt the Alliance should consider grid generation, input file generation and post-processing as part of supporting the NPARC code instead of focusing only on the code itself. The other issue discussed was how to handle proposals made for NPARC code development which involve a charge for the work proposed

Users and other interested parties are encouraged to attend User Association Meetings to discuss issues of particular concern and to help guide the future development of the NPARC code.

Upcoming NPARC User Association Meetings:

- 33rd Aerospace Sciences Meeting, January 9-12, 1995, Reno, Nevada
- 31st Joint Propulsion Conference, July 10-12, 1995, San Diego, CA

In addition to the User Association Meeting in San Diego, there will be a special NPARC technical session

featuring papers on the current status of the NPARC code and a wide range of applications. See you there!

CMOTT Joins NPARC Team

The Center for Modeling of Turbulence and Transition (CMOTT), a focus group within the Institute for Computational Mechanics in Propulsion (ICOMP) at NASA Lewis Research Center, was founded in 1990. Its objective is to develop and validate turbulence and transition models for computational fluid dynamics applied in propulsion systems. Currently, CMOTT has 6 active members with Dr. T. H. Shih as its technical leader. Over the past few years, a number of models have been developed at CMOTT, ranging from a dynamical equation for eddy viscosity to the full Reynolds stress equations. These models and their applications have been presented in ICOMP reports, conferences and workshops, and peer-reviewed scientific journal.

CMOTT aims to enhance the predicative capabilities of NPARC for turbulent flows. A separate turbulence subprogram has been written. In a computation, the subprogram interacts with the NPARC code by feeding Reynolds stresses to the NPARC code and getting the mean field information from the NPARC code. Currently, the subprogram contains a number of low-Reynolds number k–ε two-equation models. In the upcoming year, CMOTT plans to add an algebraic Reynolds stress model and the wall-function feature including the pressure gradient effects into the subprogram. The algebraic Reynolds stress model will give a better performance than the current two-equation models for flows where anisotropy is important. The wall-function feature will reduce the grid resolution requirements considerably.

For more information on CMOTT's activity related to NPARC development, contact Zhigang Yang:

email:
fsyang@icomp01.lerc.nasa.gov
Phone:
216-962-3093

Work Begun on Version 3.0

The primary development effort will be focused on modifying NPARC to allow operation on workstation clusters in parallel (see "Parallel NPARC Effort"). Simultaneously work will begin on improving the code structure to allow developers to easily add or modify sections of the code, e.g. the solver, by “plugging in” a subroutine module. This new structure will minimize development effort and allow organizations to easily update new versions of the code with in-house developments.

Other modifications to NPARC being contemplated for Version 3.0 include: simplified and generalized I/O, dynamic memory allocation, improved bleed boundary conditions, and an updated one-equation turbulence model. In addition, certain pre- and post-processing software will be made available, including an interactive input generator and initial conditions generator.

Current plans are to release version 3.0 near the end of the calendar year. Minor releases will be made if significant enhancements are available earlier. For further information, contact the NPARC support line.

Code Validation Update

Since the last newsletter, the validation team has emphasized support to the preparation of the NPARC Version 2.0 documentation with the provision of three example cases; turbulent flat plate boundary layer, supersonic axisymmetric jet, and subsonic S-duct inlet flow. The example case material was drawn from on-going validation studies which will be completed during FY95. In addition, the following problems will be included as part of the FY95 validation activities:

Sajben Diffuser
Glancing Shock Interaction
Ejector Nozzle
HSR Boat-Tail

Also, the flat plate case will be expanded to include both laminar and turbulent flow as well as the influence of heat transfer. In addition to these basically steady flows, attention will also be directed toward unsteady flow simulations representative of the unstart phenomena associated with supersonic inlets. Documentation of the validation effort will take the form of a separate validation experiences report. Access to the data used to support the validation effort will also be made available through the NPARC WWW server.

Coordination of the NPARC validation activities with other similar activities is an important element of the validation effort. At the January 1994 AIAA Aerospace Sciences meeting, the validation team had the opportunity to brief the Joint Army-Navy-NASA-Air Force (JANNAF) Airbreathing Subcommittee during the Computational Fluid Dynamics Code Validation/Calibration Workshop sponsored by the Airframe

Integration Panel. In general, the purpose of the briefing was introduce the committee to the NPARC Alliance. However, the primary focus was presentation of the then current validation plans. An update briefing will be provided at the workshop to be conducted during the 1995 Aerospace Sciences Meeting.

Through contacts made at the JANNAF meeting, the NPARC Alliance acquired computational grids for two nozzle/aft-body problems which are elements of the NASA sponsored MADIC code validation effort. These include both an axisymmetric and a 2-D planar nozzle. Initiation of these problems is pending identification of necessary manpower resources.

In addition to the MADIC effort, there also exists a NASA sponsored effort which is focusing on turbulence modeling standards. A national team, chaired by Joe Marvin of the NASA Ames Research Center and identified as the NASA Turbulence Modeling Standards Committee, has as its goal the development of a process founded on metrics that enables CFD users to make informed choices for models to implement in their codes. An NPARC validation team representative will be present at an informational meeting of the group to be held in conjunction with the 1995 Aerospace Sciences Meeting.

User's can contact the Validation team via:

- The NPARC WWW Bulletin Board
- E-mail to the validation team at: **nparc-valid@info.arnold.af.mil**
- Direct communication

NASA LeRC: Charlie Towne
E-mail: towne@lerc.nasa.gov
Phone: (216) 433-5851

AEDC: Ralph Jones
E-mail: jones@hap.arnold.af.mil
Phone: (615) 454-6876

Frequently Asked Questions

The user support team receives many calls or email messages requesting information on code operation. We thought the answers to some of the most frequently asked questions might be of interest to the community as a whole. We will be providing a more comprehensive list of FAQ's on the NPARC WWW service.

Can k–ε profiles be frozen at inflow boundaries?
Yes, there are two ways to do this. First, if the user supplies the restart file with turbulence quantities, set BC type to -10. This will hold the flow variables and the turbulence variables fixed at the inflow. Alternatively, if there is a boundary layer profile at the inflow, the code will calculate the k–ε profiles and hold them fixed by starting with the Baldwin-Lomax turbulence model and switching the the k–ε model at iteration NTURB using BC type -11. (This option is not documentated in the manual) Both of these options are generally used only for predominantly supersonic inflow boundaries. For subsonic inflow, use the free-stream turbulence option.

The code won't run "as is" on my IBM RS6000. Why?
The include file "NPARC.INC" is set up for single precision operation on an SGI workstation. Thus, NBYTE = 1. For most other machines, set NBYTE = 4 for single precision operation. For double precision operation, set NBYTE = 2 for SGI' s and NBYTE = 8 for most other machines. Note that for double precision you must compile with a double precision flag. This is not done in the code with "REAL*8" statements.

User Survey Results

A user survey was conducted in mid 1994 to help the NPARC Alliance in planning activities for FY95. The response rate to the survey was greater than 20%. We appreciate all the responses and encourage users to contact the NPARC Alliance team members with suggestions at any time. Following is a very brief summary of the survey results.

Support
The most important aspect of support to the majority of users is responsiveness to bug fixes and up-to-date documentation. Suprisingly, training did not get much support with a few clear exceptions. More feedback on this would be appreciated. Although NPARC news received more support than training, it also appears to be viewed by the users as a secondary item in importance

Development
In the Physical Modeling area, time-accuracy improvements was the only item enjoying major support. The turbulence model questions got the best overall results based on having a superior ratio of positive to negatives. User's were also supportive of dynamic memory allocation, artificial viscosity upgrades and incorporation of an upwind scheme.

Validation
While user's were generally supportive of the validation effort, there was no agreement on what types of cases should be used for validation purposes. This probably reflects the diversity of the user community.